

Measuring Unit Cost Variation Among Wheat Growers

Variation in production costs arises from several sources. Some are interrelated, while others are beyond the operators' control. In this report, sources of cost variation can be divided into four categories: (1) random cost variations that vary by year and location; (2) quality of the resources used; (3) input prices, and (4) farm and operator characteristics.

Wheat production is subject to a significant amount of variation in factors beyond the farm operators' control. The most influential factor is weather. As noted earlier, most of the 1994 wheat crop was produced on dryland under a variety of weather and soil conditions. The effects of weather on wheat yields can be substantial in any given year depending on location and type of wheat grown, and thus result in a major source of cost variation among farm operators. The variability in yields is also influenced by the differences in farm resources used in production. For example, the difference in land quality is a major source of cost variation. Wheat grown on irrigated land has less cost variation than that on dryland due to less variability in access to water during the growing season. Differences in production practices (such as double-cropping and fallow) and fluctuations in input prices may affect the mix and level of inputs used.

Costs also vary by farm characteristics, such as size, production specialty, land tenure, and availability of capital. Operator characteristics (age and educational level of operator) affect costs some, but affect management decisionmaking more.

Farm Operator Costs and Returns Accounts

To measure the influence of different variables on the cash costs of growing wheat, we must depart from traditional USDA enterprise cost and return accounting (Morehart et al., 1992). Estimates discussed thus far have included the operators' and landlords' costs and returns. Production costs paid by a landlord as part of the rental arrangement are added to the operator's costs and subtracted from the rental value of land. These traditional accounts treat all resources used in production as if the operation fully owned them and charged an opportunity cost for their use. For example, the cost of land used in the production of a commodity is charged the income that could be earned by renting the land to another producer. An

opportunity cost is also charged for resources such as capital and unpaid labor at a rate they could have earned in alternative uses. Government program costs and returns are not included in the estimates.

Because USDA's accounts include economic costs and returns to resources regardless of ownership, the enterprise cost-of-production account is called a "sector account." This implies that the account includes only the costs of having these resources invested in the farm sector and production of a specific commodity rather than elsewhere in the economy (USDA, ERS, 1997a).

Enterprise budgets developed to provide a wheat production sector perspective may not be appropriate for other data users analyzing a specific situation. For an analysis of a specific situation, the enterprise cost account developed will likely require different details and structure. The traditional account includes imputed opportunity costs to nonland capital, land, and unpaid labor, using State or regional average prices. However, each farmer has a unique combination of resources and faces somewhat unique economic conditions, such as land quality, labor skill, and local job opportunities, not reflected in State averages. Consequently, the enterprise economic costs may not be appropriate to analyze individual farms according to costs, efficiency, or other criteria. Also,

Comparison of Farm-Operator and Sectoral Approaches

The farm-operator approach differs from the sectoral approach in two important respects. In the farm-operator approach, only farm operators' costs and returns are considered, while landlords' contributions are excluded. (On share-rented acreage, only the farm operator's share of input costs and returns is included.)

The assumption of full resource ownership is removed:

Farm operators are charged only the costs incurred for using the resources in production. (Landownership costs include only real estate taxes and interest on real estate debt.)

Cash-rented land is charged according to the amount of cash-rent paid.

comparisons among farm operators cannot be examined without knowing the landownership and rental cost relationships between operator and landlord and their shares in costs and returns.

To analyze farm operators' production costs and examine farm and operator characteristics as sources of cost variation, an alternative approach to the traditional USDA accounting method has been developed that focuses only on production costs and returns of farm operators (McBride, 1994b). This approach was first used by McBride in an analysis of production costs for corn producers (McBride, 1994c). This estimation methodology has since been used to develop estimates of farm operator costs and returns for barley producers (Ali and Brooks, 1996).

Wheat Farm Operator Production Costs and Returns

The average operator's variable cash cost of producing wheat was about \$58 per acre, while total cash and noncash costs were \$107 per acre. Production costs at the regional level varied from \$92 per acre for wheat operators in the Central and Southern Plains to \$178 per acre for operators in the Pacific region. The operator cost accounts showed that U.S. farm operators received an average of 29 bushels from a total yield of 33 bushels per planted acre (table 11).

The remaining 4 bushels of wheat per acre were the landlord share.

On a per-bushel basis, the average farm operator's cost was \$3.74, which was above the value of wheat at harvesttime. Farm operators in the North Central region had the lowest costs at \$2.71 per bushel, while the highest per-bushel costs were estimated for the Central and Southern Plains operators, at \$4.03.

Farm operators' residual returns to equity, unpaid labor, risk, and management were positive only in the eastern regions. The highest positive residual returns were estimated for the North Central region at \$36 per acre due to relatively higher wheat yields and high straw value. Wheat operators in the Pacific region reported negative residual returns at minus \$11 per acre, while, in the Plains region, residual returns averaged minus \$17 per acre.

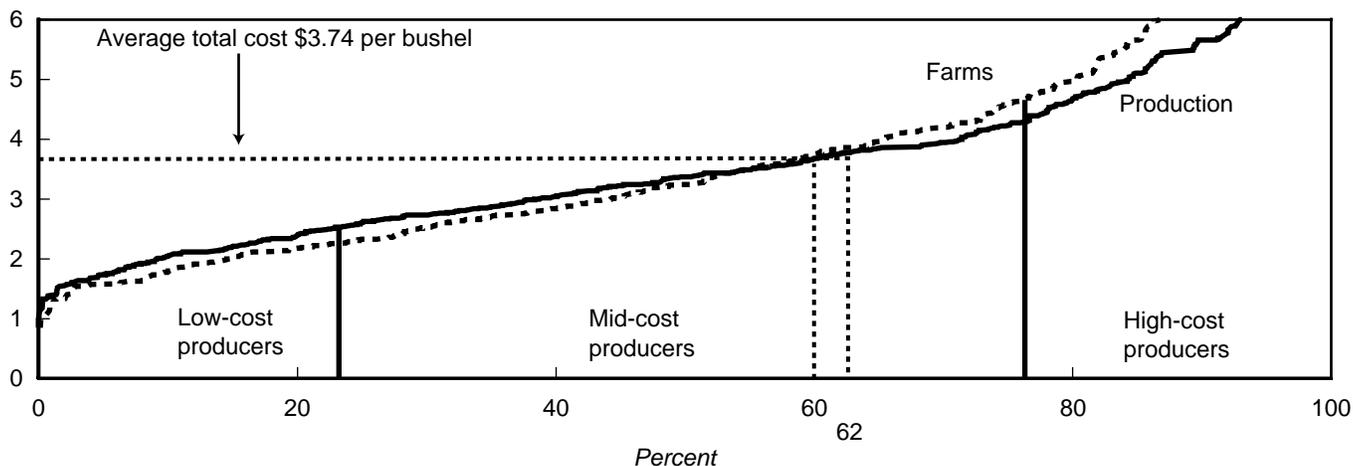
Estimated farm operator total costs (cash and noncash) were converted to a per-bushel basis and ranked from lowest to highest to construct a weighted, cumulative distribution of farms and production (fig. 12). Twenty-five percent of wheat farm operators had total costs of \$2.33 or less per bushel. These low-cost operators planted wheat on 12 percent of total farm acreage and produced about 18 percent of U.S. wheat production. At the other end of the distribution, 25

Figure 12

Cumulative distribution of wheat operators and production, by total costs, 1994

About 60 percent of Farm Costs and Returns Survey wheat farm operators, representing 62 percent of wheat production, had total costs at or below the average cost of \$3.74 per bushel.

Dollar per bushel



Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

percent of farm operators produced wheat at a cost of \$4.59 or more. High-cost operators accounted for about 34 percent of total planted acreage and 21 percent of wheat production.

Differences in actual and expected yields determine whether farm operators are low- or high-cost wheat producers (table 12). The expected yield reported by producers in the Farm Costs and Returns Survey is the yield on which production and input decisions were made. U.S. wheat farm operators expected 35 bushels per acre in 1994. They made their decisions about level and mix of production inputs based on these expected yields and on their unique resource and management skills. Low-cost operators, however, harvested an average 43 bushels per acre, about 5

bushels more than they expected because of favorable weather and good management decisions. Operators in the high-cost group expected 32 bushels, but harvested only 17 bushels of wheat per acre. As a result, high-cost operators produced wheat at \$6.55 per bushel, compared with \$1.91 per bushel for low-cost operators.

Influence of Farm and Operator Characteristics

Linear regression analysis (weighted least squares) was used to examine the statistical association between the per-unit production costs and several farm and operator characteristics (for details, see the Sources of Variation in Production Costs box). To measure the

Table 11—Farm operator wheat production cash costs and returns per planted acre, by region, 1994

Item	North		Nothern	Central and		All FCRS
	Central	Southeast	Plains	Southern Plains	Pacific	farms
	<i>Percent</i>					
Number of farm operators	33.90	5.90	23.00	31.00	6.10	100.00
	<i>Bushels per planted acre</i>					
Yield	53.44	47.03	27.85	28.46	59.96	33.40
Farm operator's share	46.99	43.62	25.86	22.72	49.47	28.77
	<i>Dollars per planted acre</i>					
Gross value of production:						
Wheat grain	137.06	125.58	85.74	69.61	165.10	91.09
Wheat straw/grazing	26.81	4.97	0.60	4.33	1.76	4.40
Total, gross value of production	163.86	130.56	86.34	73.93	166.86	95.49
Cash expenses:						
Seed	12.34	12.48	7.77	5.00	9.20	7.26
Fertilizer	34.58	32.03	12.00	11.55	24.54	15.27
Chemicals	0.81	6.74	7.49	2.45	13.82	5.42
Custom operations	4.34	6.66	2.54	8.43	7.06	5.60
Fuel, lube, and electricity	5.14	5.52	5.82	9.59	19.68	8.46
Repairs	8.17	9.53	12.07	10.83	17.82	11.66
Hired labor	1.77	6.49	2.02	3.77	10.98	3.61
Purchased water and baling	0.73	0.30	0.03	0.05	2.84	0.34
Fixed cash expenses:						
General farm overhead	8.17	4.03	4.13	5.13	9.01	5.26
Real estate and property taxes	6.43	3.03	2.14	1.78	3.49	2.47
Insurance	3.32	2.44	3.16	2.73	5.52	3.17
Interest	7.52	4.64	7.56	7.56	10.53	7.72
Land rent	15.88	16.86	13.02	3.79	7.52	9.14
Noncash expenses:						
Replacement	18.19	18.60	23.41	18.63	35.02	21.87
Hired labor benefits	0.07	0.46	0.15	0.26	0.51	0.23
Summary of expenses:						
Variable cash	67.89	79.75	49.74	51.68	105.94	57.61
Fixed cash	41.32	31.00	30.01	20.99	36.08	27.75
Noncash	18.26	19.05	23.55	18.89	35.53	22.10
Total	127.47	129.80	103.30	91.56	177.55	107.46
Residual returns to equity, unpaid labor, management, and risk	36.40	0.75	-16.96	-17.62	-10.68	-11.97

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

extent to which each characteristic influenced production costs, the sample variation of production costs per unit was decomposed into the portion attributable to each characteristic (see Kmenta, 1971, p. 410). Also given are coefficients of separate determination accounted for by each variable in the regression.

Wheat production costs were expressed on per-bushel of expected-yield basis. Expected yields were reported in the survey. Expressing costs per unit of expected yield reduces the effects of factors during the growing season that are beyond the operator's control,

such as weather and weed and pest infestations. Also farmers plan based on their expected yield, given the unique resource capabilities of individual farm operations and the selected input mix. Because production costs include only that portion paid by farm operators, expected yield on share-rented acreage includes only the portion of production received by the farm operator.

Several factors affecting the unit cost among U.S. wheat farmers are given in table 13. Size of the wheat enterprise, as measured by planted acreage, is expected to be inversely related to unit cost, because, as

Table 12—Farm operator wheat production cash costs and returns per planted acre, by total cost group, 1994

Item	Total cost group		
	Low-cost operators	Mid-cost operators	High-cost operators
	<i>Percent</i>		
Number of farm operators	25.00	50.00	25.00
	<i>Dollars per planted acre</i>		
Gross value of production:			
Wheat grain	132.24	104.77	55.37
Wheat straw/grazing	12.22	2.79	4.20
Total, gross value of production	144.47	107.56	59.58
Cash expenses:			
Seed	6.68	7.45	7.17
Fertilizer	14.07	16.13	14.34
Chemicals	2.71	5.41	6.38
Custom operations	6.81	6.20	4.23
Fuel, lube, and electricity	4.82	8.00	10.43
Repairs	8.54	11.72	12.66
Hired labor	1.81	3.51	4.39
Purchased water and baling	0.34	0.50	0.09
Fixed cash expenses:			
General farm overhead	4.92	5.49	5.03
Real estate and property taxes	4.29	2.51	1.76
Insurance	2.65	3.42	2.97
Interest	5.84	8.23	7.56
Land rent	2.00	8.98	11.86
Noncash expenses:			
Replacement	17.19	21.72	23.74
Hired labor benefits	0.06	0.21	0.30
Summary of expenses:			
Variable cash	45.78	58.91	59.69
Fixed cash	19.70	28.63	29.17
Noncash	17.25	21.93	24.04
Total	82.73	109.47	112.91
Residual returns to equity, unpaid labor, management, and risk	61.74	-1.91	-53.33
	<i>Dollars per bushel</i>		
Total costs:			
Actual yield	1.91	3.33	6.55
Expected yield	2.26	3.08	3.58

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

demonstrated previously, large farms can spread the cost of fixed inputs, such as machinery and equipment, over more units of output (also see Madden, 1967). Price discounts are also offered to farm operators who purchase inputs in large quantities (see Smith et al., 1984 and 1986).

Specialization in wheat production, as measured by the proportion of operated acreage planted to wheat, is also expected to relate inversely to production costs. Operators of more specialized farms are expected to

develop greater managerial skills and be more aware of cost-saving production techniques unique to that particular commodity than less specialized operators.

The effect of land tenure, measured as a proportion of wheat acreage cash- and share-rented, could be positive or negative depending on the relative costs of landownership and rental arrangements. Farmers with a large proportion of their acreage irrigated are expected to have high total production costs due to intensive use of inputs. However, unit cost may

Sources of Variation in Production Costs Used in This Report

Attributes of Wheat Production	Unit	Variable name
Wheat acres planted	<i>Hundreds</i>	APL
Winter wheat acres	<i>Percent of acreage</i>	PCTWW
Irrigation	<i>Percent of acreage</i>	PCTIRR
Summer fallow	<i>Percent of acreage</i>	PCTFAL
Double-cropping	<i>Percent of acreage</i>	PCTDC
Rotation	<i>1 = other crops; 0 = otherwise</i>	ROTATOH
Home-grown seed	<i>Percent of seed</i>	PCTHG
Nitrogen use	<i>Pounds per acre</i>	QNAC
Tillage and planting	<i>Hours per acre</i>	TLHRAC
Custom harvest	<i>Percent of acreage</i>	PCTCUH
No-till	<i>Percent of acreage</i>	PCTNTL
Labor use	<i>Hours per acre</i>	LHRAC
Farm Characteristics		
Cash-rented	<i>Percent of acreage</i>	PCTCRE
Share-rented	<i>Percent of acreage</i>	PCTSRE
Specialization	<i>Percent of operated acres in wheat</i>	PCTWHT
Capitalization	<i>Value of machines per acre, in 100</i>	MCHVAC
Debt-to-asset	<i>Ratio</i>	DA
Farm Operator Characteristics		
Major occupation	<i>1 = farming; 0 = otherwise</i>	OCUP
Age	<i>1 = 50 years of age or more; 0 = otherwise</i>	AGE
Education	<i>1 = high school education; 0 = otherwise</i>	EDCL

The variables which had the greatest influence on variations in per-bushel production costs were:

Value of machines per acre
Share-rent
Custom harvest
Irrigation
Cash-rent

Together these five variables accounted for 90 percent of the variation in per-bushel production costs. Machine value per acre alone explained 44 percent of the variation.

Variance effects for the variables used are shown in table 15.

Table 13—Mean and coefficient of variation of the sample variable, U.S. wheat farm operators, 1994

Variable name	Unit	Mean	Coefficient of variation Percent
EXTCBU	Total cost per bushel of expected yield	2.997	2.47
APL	Wheat acres (Hundreds)	2.136	6.73
ROTATOH	1 = rotation with other crops, 0 = otherwise	0.829	2.34
PCTHG	Percent of home-grown seed	0.296	8.24
QNAC	Pounds of nitrogen per acre	60.922	4.37
TLHRAC	Tilling/planting hours per acre	0.767	25.57
PCTCUH	Percent of custom acres	17.482	12.11
LHRAC	Labor hours per acre	2.442	9.92
PCTIRR	Percent of irrigated acres	4.512	14.15
PCTFAL	Percent of fallow acres	20.529	11.33
PCTDC	Percent of double-cropped acres	9.297	12.29
PCTNTL	Percent of no-till acres	12.143	13.86
PCTWW	Percent of winter wheat acres	77.730	3.18
PCTSRE	Percent of share-rented acres	26.999	8.35
PCTCRE	Percent of cash-rented acres	19.706	10.15
PCTWHT	Percent of operated acres in wheat	22.280	5.64
MCHVAC	Machine value per acre	5.279	2.42
DA	Ratio	0.174	7.72
AGE	1 = 50 years or more of age, 0 = otherwise	0.555	5.86
EDCL	1 = high school education, 0 = otherwise	0.570	5.38
OCUP	1 = major occupation is farming, 0 = otherwise	0.850	2.52

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

decline if yield increases more than costs. Producers who rotate wheat with other crops are expected to have low unit costs. Reductions in costs due to crop rotation depend on the type of crop grown. For example, planting wheat after soybeans (a legume crop) will reduce nitrogen fertilizer use, while rotating wheat with row crops like corn will reduce chemical use due to the break in pest and insect life cycles. Farm operators using a large proportion of home-grown seed are expected to have lower costs than those using purchased seed. Usually, extensive use of inputs, such as nitrogen, machinery, and labor, can be positively related to unit cost. The practice of double-cropping may increase unit costs through supplying inputs to two crops. Planting wheat on fallow land may lower the input costs mainly because of less need for nitrogen and chemical use. Among custom

operations, harvesting will have a measurable influence on unit cost.

The effects of financial conditions on unit costs were also examined. We used: (1) degree of capitalization, as measured by the average value of machines invested in wheat production; and (2) farm debt-to-asset ratio as our measure of financial condition of the farm. We expected all financial measures to be positively related to unit cost (as degree of capitalization or debt-asset ratio increases, unit costs are expected to increase as well).

Farm operator characteristics include major occupation, age, and education. Major occupation is defined as the job, farming or otherwise, on which the operator spent most of his/her time during 1994. Farm

operators whose major occupation was farming are expected to have lower production costs than others. The influence of age on unit production costs is difficult to examine. Younger producers may be more willing to try new cost-saving production techniques because of their long-planning horizon that makes them more likely to be risk-takers than their older counterparts. However, younger farmers more often require debt financing, which increases unit cost. Education is expected to be negatively related to unit production costs, measured as those who graduated from high school or college and otherwise (Khalidi, 1975; and Rahm and Huffman, 1984). More educated farmers tend to invest in cost-reducing technologies and to allocate inputs more efficiently, thereby reducing production costs.

Table 13 shows the means and coefficient of variation of variables used in the regression at the U.S. level. As discussed earlier in this report, location is a major source of cost variation that influences land quality, production practices, type of wheat grown, and input use.

The relationship between costs per bushel of expected yield and several farm and operator characteristics was estimated for wheat farm operators. While the estimated coefficients in table 14 describe the change in wheat production cost per bushel from a unit change in each variable, the t-statistics suggest which estimated coefficients are significantly different from zero. The R-squared of 0.33 suggests that explanatory variables used in the regression explained 33 percent of the variation in the unit cost of wheat farm operators. Among the farm structural characteristics, land tenure, irrigation, custom harvesting, and capitalization were significant determinants of unit production cost.

As expected, land-tenure, capitalization, and custom harvesting were positively associated with unit cost. Planting wheat on either share- or cash-rented land resulted in higher unit cost than on owned land. Unit costs were higher on share-rented land than on cash-rented land. Increasing the wheat acreage custom-harvested by 1 percent raised the unit cost by 1 cent. Use of irrigation significantly lowers the unit cost. The coefficient on irrigation suggested that unit costs will decrease by 1.51 cents for every percentage-point increase in irrigated acres. Use of home-grown seed was not significant and was negatively related to unit cost. Coefficients on nitrogen use, tillage hours, labor

hours, and planting wheat on fallow and double-cropped land are not significant, but all are positively related to the unit cost. Coefficient on no-till is negatively related to unit cost, implying that operators using no-till had lower unit costs than those using conventional tillage.

Operator characteristics were not significantly related to unit cost (table 14). The coefficient on the age variable suggests that age was positively related to unit cost, which also implies that operators older than 50 years have a higher unit cost than younger operators. Operators' major occupation and education level were negatively related to unit cost, meaning that those whose major occupation was farming and those who had the most education had lower unit costs.

To examine how each variable used in the regression contributed to the variation in the unit costs, decomposition of unit cost variation and coefficient of separate determination that contributed to each variable used in the regression are given in tables 15 and 16. Variance effects suggest how much variation in unit cost can be attributed solely to each explanatory variable. The percentage of total variance effects for each variable suggests each variable's contribution to unit cost variation in relation to other variables.

Among all variables, capitalization (average machine investment per wheat acre) had the greatest influence on unit cost variation, explaining 44 percent of total variance effects. Share-rent and custom harvest were next (accounting for 15 percent), followed by cash-rent and irrigation (accounting for 8 to 10 percent of variance effect). Specialization, labor, and debt-to-asset ratio accounted for 1 to 3 percent of the variance effects. Size, tillage, type of wheat, fallow, double-cropping, and operator's occupation and education had little influence on the unit cost (explaining less than 1 percent of the variance effect).

Table 16 shows the results relating to the coefficient of separate determination for variables influencing the unit cost of U.S. wheat production. Based on this statistic, capitalization is the most important variable explaining the variation in the unit cost (0.158). The coefficients of separate determination on share-rented land, custom harvesting, irrigation, and cash-rent are at 0.0792, 0.0349, 0.0285, and 0.0209, respectively, showing measurable influence on the unit cost of wheat production.

Table 14—Regression estimates of the unit cost for U.S. wheat farm operators, 1994

Variable	Coefficient estimates	t-statistics
INTERCEPT	1.0863 ***	3.08
APL	-0.0086	-0.59
ROTATOH	0.0253	0.15
PCTHG	-0.1319	-1.13
QNAC	0.0011	0.73
TLHRAC	0.0164	0.21
PCTCUH	0.0101**	4.20
LHRAC	0.0547	1.54
PCTIRR	-0.0151***	-3.63
PCTFAL	0.0012	0.73
PCTDC	0.0025	1.40
PCTNTL	-0.0017	-1.22
PCTWW	-0.0007	-0.59
PCTSRE	0.0097***	5.42
PCTCRE	0.0076***	5.67
PCTWHT	0.0043	1.17
MCHVAC	0.2339***	6.34
DA	0.5261	1.61
AGE	0.0483	0.41
EDCL	-0.0790	-0.68
OCUP	-0.1977	-0.89
F-statistic	9.37	
R-squared	0.33	

** = Significant at the 5-percent level.

*** = Significant at the 1-percent level.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Regional Differences in Unit-Cost Variation

Weighted least-squares regression analysis is also used to examine and test the relationship between unit cost of production and selected variables on farm and operator characteristics in each region. For this purpose, the unit cost equation estimated in each region includes only factors important to all regions. Factors specific to a particular region, such as irrigation in the Pacific, fallow in the Pacific and

Northern Plains, double-cropping in the Southeast, and no-till in the Southeast and North Central regions are excluded (table 17). The sample variation of unit cost is also decomposed into the portion attributable to each variable (table 18). The coefficients of separate determination for each variable in the regression are given in table 19. Differences in several attributes of wheat production in the regions are identified by testing for differences in coefficients estimated for each region. For this purpose, a t-statistic for testing

Table 15—Contribution of factors to the unit cost variation for wheat operators, 1994

Variable	Variance effect	Percent of variance effect
APL	0.0009	0.10
ROTATOH	0	0.01
PCTHG	0.0032	0.34
QNAC	0.0024	0.26
TLHRAC	0.0006	0.06
PCTCUH	0.1424	14.91
LHRAC	0.0287	3.01
PCTIRR	0.0915	9.58
PCTFAL	0.0022	0.24
PCTDC	0.0047	0.50
PCTNTL	0.0031	0.33
PCTWW	0.0008	0.09
PCTSRE	0.1447	15.15
PCTCRE	0.0734	7.69
PCTWHT	0.0089	0.94
MCHVAC	0.4164	43.59
DA	0.0234	2.46
AGE	0.0005	0.06
EDCL	0.0015	0.16
OCUP	0.0050	0.52
Total	0.9555	100.00

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

the equivalence of two regressions is used to measure significant differences (see the appendix).

Usually unit cost is significantly different between the Northern Plains and Central and Southern Plains and the North Central and Southeast. The unit cost in the Central and Southern Plains region is significantly lower from the unit cost in the Pacific and Southeast regions, but not significantly different from that of the Northern Plains. The North Central region usually has a significant cost advantage over the Southeast.

Regression coefficients and their significance levels by region are given in table 17. Table 20 provides t-statistics that test for significant differences between the regions. These t-statistics suggest whether the estimated coefficients in a region are different from the estimated coefficients in other regions. For example, the t-statistic between the Pacific and Southeast regions for the coefficients on rotation shows a significant difference. Also this shows that the influence of rotation on unit cost is different in the Pacific region than in the Southeast. Rotation with

Table 16—Coefficient of separate determination for factors affecting farm operators' unit cost, 1994

Variable	Coefficient of separate determination
APL	-0.0026
ROTATOH	-0.0002
PCTHG	0
QNAC	0.0032
TLHRAC	0.0006
PCTCUH	0.0349
LHRAC	0.0146
PCTIRR	-0.0285
PCTFAL	0.0032
PCTDC	0.0015
PCTNTL	0.0036
PCTWW	0.0002
PCTSRE	0.0792
PCTCRE	0.0209
PCTWHT	0.0129
MCHVAC	0.1586
DA	0.0199
AGE	-0.0017
EDCL	0.0033
OCUP	0.0039
Total	0.3280
Unexplained	0.6719

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

other crops in the Southeast reduced unit costs, because wheat is usually rotated with soybeans.

Capitalization is the only variable that had a significant influence on the unit cost in all regions. However, its effect on unit cost is significantly more in the Northern Plains and North Central, accounting for 39 percent of the variation in unit costs, compared with 15 to 25 percent in other regions.

Coefficients on share-rent, cash-rent, and custom harvest suggest that they have measurable influence on unit cost in all regions except the Pacific region. In the Plains regions, share-rent alone explained 22 to 35 percent of the variation in the unit cost. Custom harvest is the most influential factor in the Southeast, followed by Northern Plains (31 and 19 percent variation in the unit cost, respectively).

Table 17—Regression estimates of the unit cost for wheat farm operators, by region, 1994

Variable	North Central	Southeast	Northern Plains	Central and Southern Plains	Pacific
INTERCEPT	0.0271	3.5882 ***	0.8374	0.6478	3.3034 ***
APL	0.0623	0.0716	-0.0040	-0.0013	0.0055
ROTATOH	0.1799	-2.3248 ***	0.2672	0.0888	0.6579 *
PCTHG	-0.0685	-0.0714	-0.1216	-0.4109 **	0.4196 *
QNAC	0.0001	0.0018	-0.0007	0.0062 **	-0.0028 *
TLHRAC	0.0129	-0.0870	0.2441	0.6729 *	-0.9112 ***
PCTCUH	0.0122 **	0.0107 ***	0.0126 ***	0.0086 **	0.0018
LHRAC	0.0865 ***	-0.0566	-0.0764	0.1117	-0.0251
PCTSRE	0.0046 **	0.0088 **	0.0139 ***	0.0128 ***	0.0017
PCTCRE	0.0124 ***	0.0056 **	0.0082 ***	0.0040 *	0.0046
PCTWHT	0.0103	-0.0157 *	0.0025	0	0.0023
MCHVAC	0.3673 ***	0.1936 **	0.2749 ***	0.1386 ***	0.0864 ***
DA	1.7166 ***	0.4794	0.0628	0.2711	0.8903*
AGE	0.6209 ***	-0.1422	-0.3692 **	0.0493	-0.3945
EDCL	-0.1289	0.2787	-0.1130	-0.1663	0.5640 **
OCUP	-0.6196 *	0.3817	0.1202	0.1814	-1.0150 *
F-statistic	7.4300	42.7100	8.5600	4.6900	7.4700
R-squared	0.5800	0.3100	0.5600	0.3300	0.3000

* = Significant at the 10-percent level.

** = Significant at the 5-percent level.

*** = Significant at the 1-percent level.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Nitrogen fertilization and tillage hours per acre are important factors in the Central and Southern Plains and Pacific regions. However, their influence on the unit cost is different. An increase in nitrogen application appears to increase the unit cost in the Central and Southern Plains, while reductions in the unit cost in the Pacific region are due to irrigation.

Labor has significant influence on the unit cost only in the North Central region, suggesting that efficiency in labor will significantly lower the unit cost more in the North Central region than in other regions.

Rotation with other crops has a significant influence on the unit cost in the Pacific and Southeast regions.

Rotating wheat with other crops significantly reduces the unit costs in the Southeast, while increasing the unit cost in the Pacific region. Note that wheat is usually rotated with soybeans in the Southeast, a legume crop that builds soil nitrogen and, consequently, is beneficial to a wheat crop.

Financial position, measured as the debt-to-asset ratio, had measurable influence and was positively related to unit cost in the North Central and Pacific regions. Among operator characteristics, farming as a major occupation in the North Central and Pacific regions, age in the North Central and Northern Plains, and education in the Pacific region had measurable influences on unit cost.

Table 18—Contribution of factors to the unit cost variation for wheat farm operators, by region, 1994

Variable	North Central	Southeast	Northern Plains	Central and Southern Plains	Pacific
APL	0.14	2.02	0.04	0	0.11
ROTATOH	0.01	5.51	0.92	0.22	6.24
PCTHG	0.06	0.12	0.39	4.15	3.53
QNAC	0	1.57	0.10	5.20	4.76
TLHRAC	0.10	0.18	0.90	4.30	22.68
PCTCUH	7.26	30.92	19.42	17.46	1.00
LHRAC	11.72	3.26	0.99	4.29	3.06
PCTSRE	2.53	13.15	22.46	34.96	0.92
PCTCRE	15.91	9.58	10.89	2.19	3.96
PCTWHT	0.70	8.37	0.45	0	0.31
MCHVAC	38.68	15.18	38.79	24.27	19.31
DA	8.34	3.39	0.02	1.51	3.87
AGE	9.25	0.83	4.14	0.07	6.37
EDCL	0.35	3.06	0.36	0.76	11.85
OCUP	4.97	2.86	0.13	0.62	12.02
Total	100.00	100.00	100.00	100.00	100.00

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Table 19—Coefficient of separate determination for factors affecting unit cost for wheat farm operators, by region, 1994

Variable	North Central	Southeast	Northern Plains	Central and Southern Plains	Pacific
APL	0.0011	0.0048	-0.0032	0	0.0036
ROTATOH	0	0.0280	-0.0007	0.0011	0.0175
PCTHG	-0.0020	0.0042	0.0008	0.0122	0.0056
QNAC	0	0.0098	-0.0083	0.0262	0.0018
TLHRAC	0.0024	0.0067	0.0080	0.0223	0.0983
PCTCUH	0.0206	0.0924	0.0510	0.0197	-0.0073
LHRAC	0.0848	0.0150	0.0117	0.0268	0.0109
PCTSRE	0.0115	0.0382	0.1610	0.1136	0.0043
PCTCRE	0.0772	0.0599	0.0642	-0.0062	0.0189
PCTWHT	0.0061	0.0201	0.0208	0	0.0091
MCHVAC	0.2615	-0.0134	0.1842	0.0961	0.0472
DA	0.0495	0.0182	0.0016	0.0114	0.0114
AGE	0.0188	0.0125	0.0653	-0.0007	0.0309
EDCL	-0.0001	0.0011	0.0082	0.0060	-0.0024
OCUP	0.0471	0.0125	-0.0002	0.0004	0.0494
Total	0.5788	0.3107	0.5647	0.3291	0.2997
Unexplained	0.4211	0.6892	0.4352	0.6708	0.7002

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.

Table 20—Estimated t-statistics on regression coefficients on factors affecting operator's unit costs, by region, 1994

Variable	Central and Southern Plains & Northern Plains	Central and Southern Plains & Pacific	Central and Southern Plains & North Central	Central and Southern Plains & Southeast	Northern Plains & Pacific
REG	-0.26	-2.51**	0.85	-3.39***	-2.24**
APL	0.09	-0.25	-0.74	-1.37	-0.37
ROTATOH	-0.56	-1.22	-0.23	4.26***	-0.90
PCTHG	-1.24	-2.77***	-1.13	-1.15	-1.86*
QNAC	1.71*	2.54**	1.65*	1.15	0.68
TLHRAC	0.92	3.36***	1.82*	1.83*	2.70***
PCTCUH	-0.88	1.50	-0.61	-0.44	2.69***
LHRAC	1.28	1.13	0.20	1.34	-0.58
PCTSRE	-0.25	2.72***	2.07**	0.80	3.28***
PCTCRE	-1.16	-0.15	-2.31**	-0.45	0.84
PCTWHT	-0.36	-0.30	-0.99	1.55	0.02
MCHVAC	-2.15**	0.94	-3.24***	-0.61	3.49***
DA	0.45	-1.15	-2.55**	-0.41	-1.44
AGE	1.53	1.32	-1.92*	0.59	0.08
EDCL	-0.20	-2.16**	-0.14	-1.60	-2.03**
OCUP	0.12	1.77*	1.60	-0.34	1.66*

Variable	Northern Plains & North Central	Northern Plains & Southeast	Pacific & North Central	Pacific & Southeast	North Central & Southeast
REG	1.04	-3.01***	2.95***	-0.23	-3.86***
APL	-0.77	-1.43	-0.65	-1.25	-0.09
ROTATOH	0.25	4.78***	0.98	4.60***	4.27***
PCTHG	-0.18	-0.17	1.39	1.42	0
QNAC	-0.26	-0.76	-1.15	-1.71*	-0.59
TLHRAC	0.77	0.91	-2.97***	-2.20**	0.47
PCTCUH	0.07	0.46	-1.88*	-2.13**	0.27
LHRAC	-1.79*	-0.21	-3.19***	0.75	2.92***
PCTSRE	2.59***	1.08	-0.87	-1.54	-0.93
PCTCRE	-1.05	0.64	-1.81*	-0.24	1.67*
PCTWHT	-0.70	1.66*	-0.69	1.57	1.93*
MCHVAC	-1.32	0.90	-4.48***	-1.26	1.82*
DA	-2.76***	-0.76	-1.24	0.66	1.93*
AGE	-4.04***	-0.83	-3.23***	-0.74	2.55**
EDCL	0.06	-1.45	2.07**	0.82	-1.51
OCUP	1.46	-0.45	-0.56	-1.85*	-1.68*

* = Significant at the 10-percent level.

** = Significant at the 5-percent level.

*** = Significant at the 1-percent level.

Source: U.S. Department of Agriculture's 1994 Farm Costs and Returns Survey.